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Determinants and Effects of Information Sharing with Key Suppliers

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Abstract

This paper focuses on information sharing with key suppliers and seeks to explore the factors that might influence its extent and depth. We also investigate how information sharing affects a company's performance with regards to resource usage, output, and flexibility. Drawing from transaction cost- and contingency theories, several factors, namely environmental uncertainty, demand uncertainty, dependency and, the product life cycle stage are proposed to explain the level of information shared with key suppliers. We develop a model where information sharing mediates the (contingent) factors and company performance.

A mail survey was used to collect data from Finnish and Swedish companies. Partial Least Squares analysis was separately performed for each country (n=119, n=102). There was consistent evidence that environmental uncertainty, demand uncertainty and supplier/buyer dependency had explanatory power, whereas no significance was found for the relationship between product life cycle stage and information sharing. The results also confirm previous studies by providing support for a positive relationship between information sharing and performance, where output performance was found to be the most strongly related.

Introduction

There is a large body of research investigating the merits of interfirm collaboration on supply chain performance. This stream of research gained momentum with the development of advanced interorganizational information systems based on Electronic Data Interchange and Internet, mainly after the IT revolution of the 1990's. Often, these technologies are promoted together with new supply chain philosophies such as Collaborative Planning Forecasting and Replenishment and Advanced Planning and Scheduling, which engage multiple parties in decision making on issues such as inventory management and capacity planning. There seems to be a pay-off for investing resources into these schemes as recent studies have found empirical evidence about a positive relationship between various forms of collaboration and performance (e.g. Bagchi and Skjoett-Larsen 2005, Petersen et al. 2005, Saeed et al. 2005, Li et al. 2006). These findings support the conventional wisdom in supply chain literature that the more integration there is, the better the performance (Bagchi and Skjoett-Larsen 2005). Despite this view, companies have been somewhat slow and hesitant to adopt these technologies and supply chain practices (Bagchi and Skjoett-Larsen 2005, Kemppainen and Vepsäläinen 2003). This can be perhaps explained through the existence of a different view – that companies should go for limited or selective collaboration (Bask and Juga 2001). This raises the question why collaboration efforts are not uniform across companies and possibly industries? Although there is some indication on what factors might influence the decision of companies to collaborate with for example a key supplier (other than financial costs), there is a lack of empirical evidence.

As collaboration in one form or the other requires the exchange of proprietary information, the role of trust, which has been extensively studied in interorganizational relationships, cannot be neglected. However, trust cannot be the only determining factor.

Transaction costs and information sharing

This paper focuses on information sharing with key suppliers and seeks to explore the factors that might influence its extent and depth, as well as its effect on the focal company's performance. The starting point for the analysis is transaction cost theory, which explains why certain tasks are performed by firms and others by markets (Coase 1937). Transaction costs can be divided into coordination costs and transaction risk (Clemons and Row 1992). "Coordination costs are the direct costs of integrating decisions between economic activities. Transaction risk is associated with the exposure to being exploited in the relationship" (Clemons and Row 1992, 3). Uncertainty and asset specificity (Williamson 1975, 1985) are two factors, which increase coordination costs and transaction risk respectively. ´

The use of Information Technology has facilitated the reduction of coordination costs, which has been extensively documented in the literature (e.g. Bakos 1991, Cash and Konsynski 1985, Johnston and Vitale 1988). Also collaboration in terms of information sharing can lower transaction costs as companies can thereby reduce supply chain uncertainty. A popular example often shown in the supply chain literature is the reduction of the bullwhip effect (Lee et al. 1997), which is the result of sharing demand forecast information with other companies in the supply chain. Furthermore, information sharing can reduce companies' internal risk as they can, among others, optimize inventory, production, and capacity planning as a result of lower uncertainty. Although, cooperation seem to bring with it many benefits, it can also increase transaction risk simultaneously as higher levels of business transparency can lead to opportunistic behaviour. Hence, uncertainty is a factor that can affect companies'

incentives to share information. This also agrees with contingency theory, which states that the amount of uncertainty and rate of change in an environment affects the development of internal features in organizations (Lawrence and Lorsch in 1967). With respect to the sign of this relationship, the literature is ambiguous. Fisher (1997) and Kaufman and Mohtadi (2003) claim that there is a negative relationship between uncertainty and information sharing. On the other hand, Xu (1996) claims that manufacturers will find it more difficult to plan when demand is more variable, encouraging them to share more information. The relationship between uncertainty (demand uncertainty in Kulp, 2002 and environmental uncertainty in Li and Lin, 2006) and information sharing (operationalized as the extent of Vendor Managed Inventory in Kulp) was hypothesized previously but no support was found. Based on the theory and previous research, we formulate the following two hypotheses.

Hypothesis 1: Environmental uncertainty is positively related to the intensity of information shared with key suppliers.

Hypothesis 2: Demand uncertainty is positively related to the intensity of information shared with key suppliers.

As mentioned before, asset specificity can increase transaction risk, which might be alleviated by greater integration between companies. This might also lead to higher trust. Asset specificity refers to the degree of investment made by the supplier of goods and/or services for a specific buyer (Williamson, 1985). Asset specificity can be regarded as a lock-in or as some degree of dependency on the other firm. Dependency between companies is a function of the criticality of the resource (Thompson 1967; Pfeffer and Salancik 1978; Bourantas 1989, Sririam, Krapfel and Spekman 1992; DeJong and Noteboom 2000) and availability of alternative suppliers and/or buyers (Thompson 1967; Pfeffer and Salancik; Sririam, Krapfel and Spekman 1992; Geykens et al. 1996; Kim 2001; Buvik and Halskau 2001). Also switching costs have been found to play a role in determining the level of dependency (Bourantas 1989; Sririam, Krapfel and Spekman 1992; Johnson 1999; Buvik and Halskau 2001). Switching costs are those costs incurred when having to switch from one supplier to another when purchasing the same goods. The costs might be both monetary (labor time spent) and non-monetary (including routines and procedures for dealing with a particular supplier) (Dick and Basu 1994, Heide and Weiss 1995). Thus, we formulate the following hypotheses.

Hypothesis 3: Key supplier's dependence on the buyer is positively related to the intensity of information shared with key suppliers.

Hypothesis 4: Buyer's dependence on the key supplier is positively related to the intensity of information shared with key suppliers.

When companies share information with trading partners, trust becomes a central issue. Greater levels of trust increase the probability of a firm's willingness to expand the amount of information shared through EDI (Hart & Saunders, 1997). According to Hart and Saunders (1997), trust between organizations in EDI implementations consists of competence (how efficiently information is processed), openness (the ability to listen and share new ideas), caring (joint goal setting and refraining from opportunism), and reliability (consistent behaviour).

Not surprisingly, Bagchi and Skjoett-Larsen (2005) note that companies are cautious when sharing information. This finding is consistent with Kemppainen and Vepsäläinen

(2003), Akintoye et al (2000), Eng (2003), Dekker (2003), and Bagchi and Skjoett-Larsen (2002), where resistance to sharing proprietary data is either found or argued. Furthermore, Wagner (2003) finds patterns relating to the phase of integration efforts (e.g. product development stage) and the intensity of integration with suppliers. For example, the optics and precision industry (e.g. cameras, medical and surgical devices) tends to integrate only at a latter stage (industrial stage), as they often need to protect their know-how by avoiding integration at the R&D stage. Bagchi and Skjoett-Larsen (2002) claim that companies in rapidly evolving industries prefer not to integrate but as the opportunistic behavior threat recedes with industry maturity, firms open up gradually. Also Fisher (1997) and Kaufman and Mohtadi (2003) argue that manufacturers with stable demand are more likely to share information. Thus, we propose the fifth hypothesis based on the product life cycle stage of the focal company.

Hypothesis 5: The intensity of information shared with key suppliers is positively related to the product life cycle stage of the buyer.

Finally, we propose that information sharing leads to better performance, which has been previously reported by Bagchi and Larsen (2005, Cassivi et al. 2004 and Petersen et al. 2005, Frohlich and Westbrook 2001). We distinguish between 3 performance measures in the supply chain - for output, resource and flexibility (Beamon 1999). This leads to the following 3 hypotheses.

Hypothesis 6a: The intensity of information shared with key suppliers is positively related to resource performance.

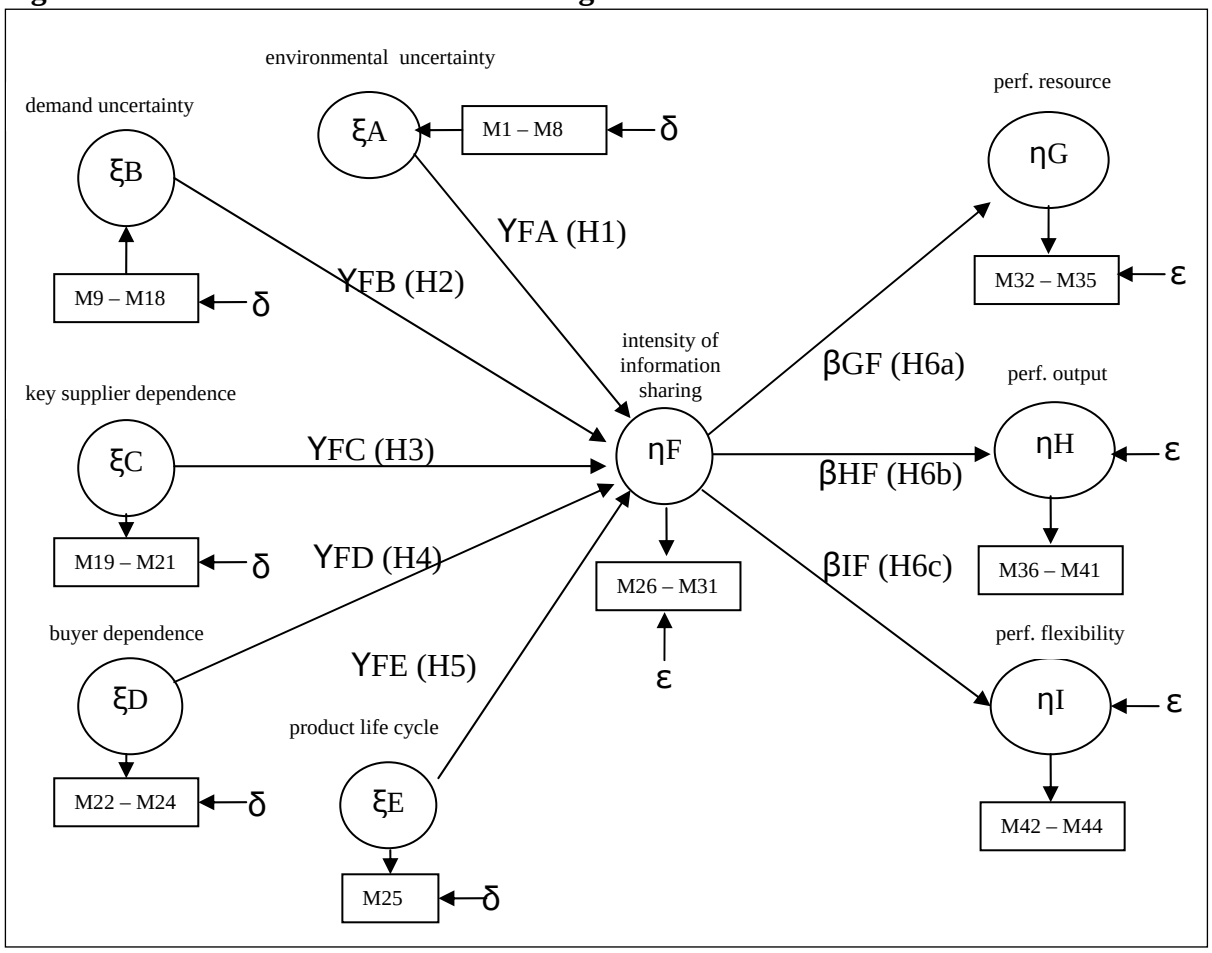
Hypothesis 6b: The intensity of information shared with key suppliers is positively related to output performance.

Hypothesis 6c: The intensity of information shared with key suppliers is positively related to flexibility performance.

Methodology

The proposed model is presented below, where information sharing mediates the contingent factors and performance.

Figure 1: A Model for Information Sharing



Exogenous Latent Variables A,B,C,D,E Endogenous Latent Variables F,G,H

To test the model, two samples, one for Finnish and the other for Swedish companies were used. The Swedish sample was used to confirm the results. The samples were obtained from the "Voitto" and "Largest Companies" databases respectively, which were accessible from the university's network. Only non-service companies with a turnover in excess of 15 million EUR were included. The sample totaled 2460 firms out of which 1170 were Finnish and 1290 were Swedish companies.

Measurement of Variables

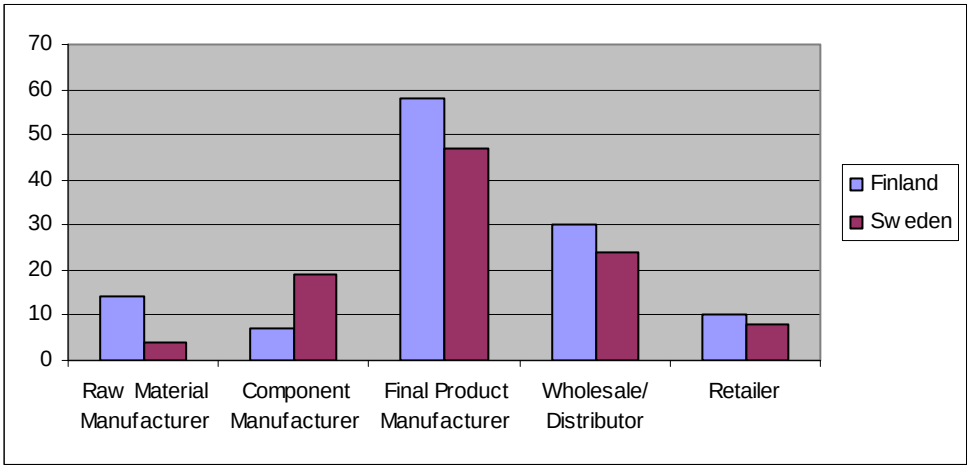
A questionnaire was developed to collect data from the companies, which was reviewed by four academicians. All variables except company background information and the product life cycle stage were measured on a 7-point Likert scale. We operationalized the model using pre-tested instruments (Appendix 1).

Environmental uncertainty and demand uncertainty were adopted from Hoque (2004) and Ho et al. (2005) respectively, where the measures have been found to perform well, although in different contexts. The measure for buyer dependency was borrowed from Straub

et al. (2004) and supplier dependency was subsequently developed based on the former. The measure for product life cycle stage was adopted from Hoque and James (2000), where respondents were asked to estimate what percentage of their products were in the different stages of the product life cycle. The intensity of information sharing was borrowed from Li et al. (2006) consisting of six indicators. The measure for performance was adopted from Beamon (1999) supporting the view that a multidimensional scale should be used to capture the different characteristics of supply chain performance.

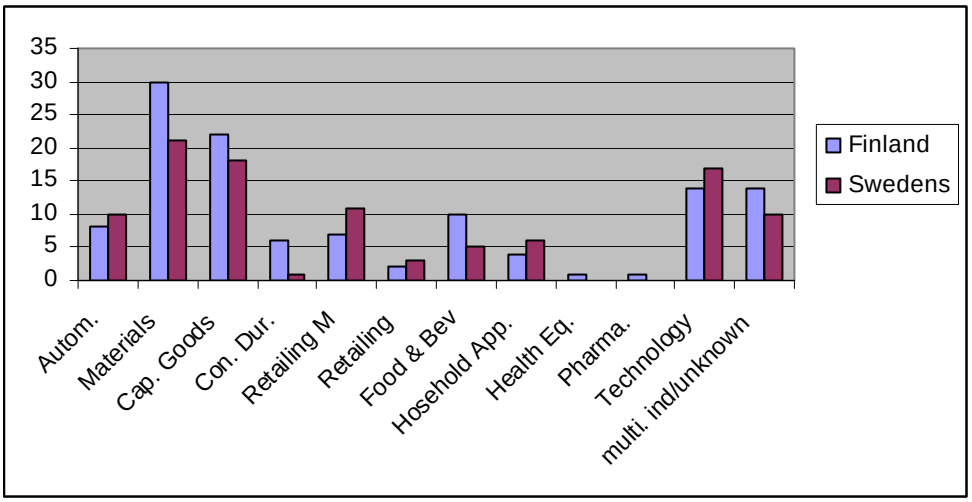
The questionnaire was sent in April and May 2006 to purchasing managers. Response rate was about 11%. The number of usable responses equaled to 119 for Finland and 102 for Sweden. The distribution of the companies both for Finland and Sweden according to their position in the supply chain is illustrated in Figure 2.

Figure 2: Position in the supply chain



Almost half of the companies were final product manufacturers. The wholesale/distributor category was the second largest. The industry of the respondent companies is shown in Figure 3. About a third of the companies were in the materials industry. Capital goods and technology ranked second and third respectively.

Figure 3: Industry



Turnover in million EUR of the respondent companies is illustrated in Figure 4. The distribution for the middle categories was similar. The category representing the smallest companies (49 million EUR or below) accounted for nearly half of the responses.

Figure 4: Turnover in million EUR

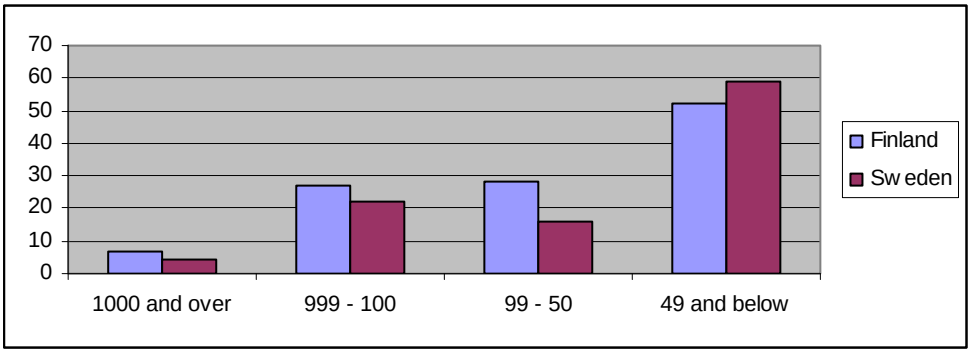
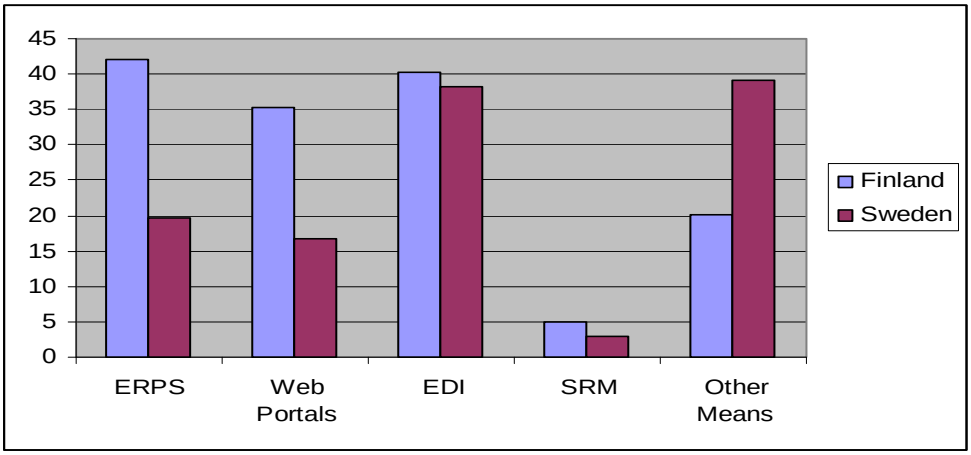
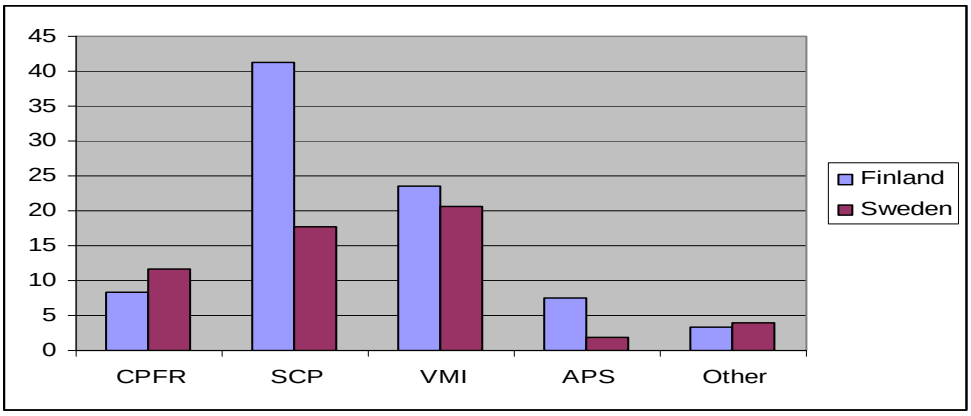


Figure 5: A comparison of IT usage for information sharing in Finland and in Sweden



ERPS: Enterprise Resource Planning Systems
EDI: Electronic Data Interchange
SRM: Supplier Relationship Management Softwares
Other Means: Refers to more traditional ways of communication: i.e. telephone, fax, and meetings

Figure 6: A comparison of supply chain practices in Finland and in Sweden



CPFR: Collaborative Planning, Forecasting and Replenishment
SCP: Supply Chain Planning
VMI: Vendor Managed Inventory
APS: Advanced Planning and Scheduling
Other: e.g. fax, e-mail

Figures 5 and 6 illustrate the usage of supply chain technologies and practices in Finland and in Sweden. With respect to the usage of technologies, Finland had clearly an advantage. Regarding supply chain practices, differences were smaller, although they were somewhat in favour of Finland. Most used practices were supply chain planning and VMI.

Statistical analysis and results

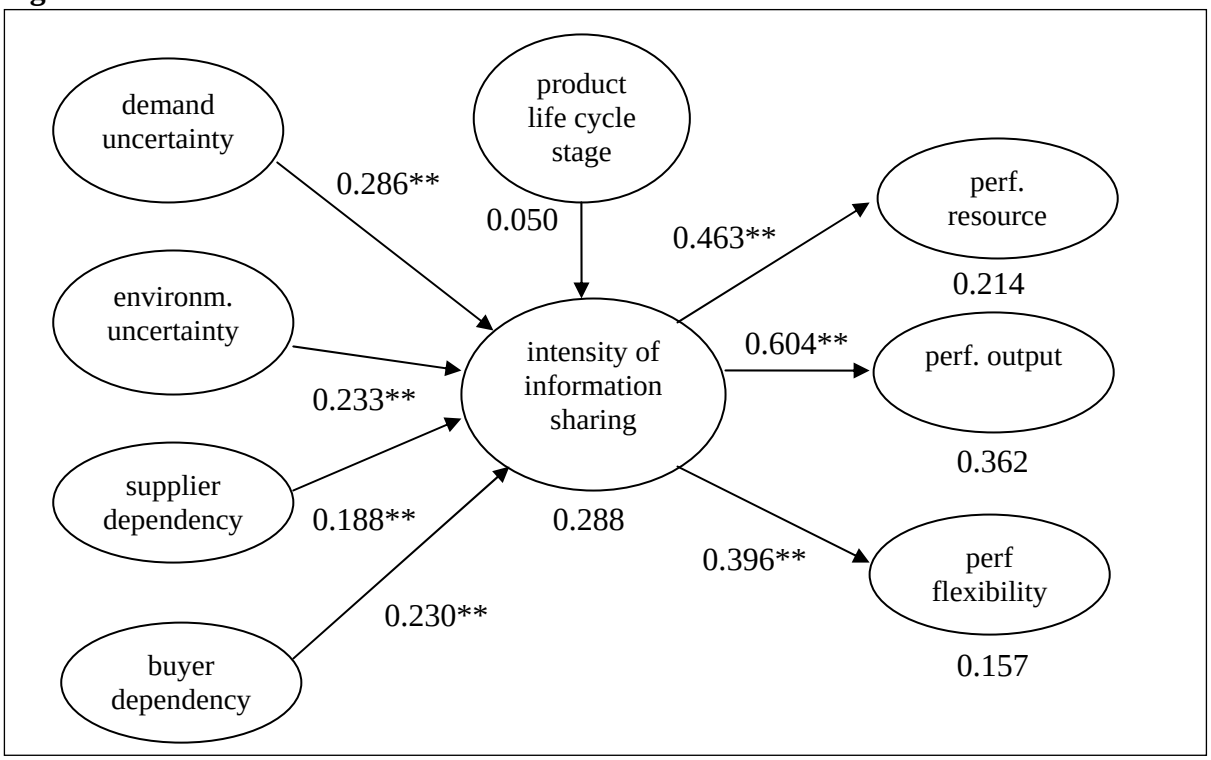
Confirmatory factor analysis was performed for reflective constructs. All factor analyses were based on the principal axis factoring – direct oblimin rotation method. Oblimin rotation was used as high correlations between indicators were found. Only components with an Eigenvalue above one were included. Pairwise deletion for missing values was used and no large outliers were found in the data, which could skew the results. This was verified by comparing the 5% Trimmed Mean values with the non-trimmed mean values, which were very close.

The results of the factor analysis for the reflective measures are presented in Appendix 1. Although, the dimensions for the performance measures were known from Cassivi et al. (2004), an exploratory factor analysis on all the items in the three dimensions was performed. This had not been done before to my knowledge. The factor analysis resulted in 3 components, consistent with the number of underlying dimensions (resource, output, flexibility). However, the indicators were not exactly clustered as according to the given dimensions. Loadings and scale reliabilities (Cronbach alpha) were sufficient (loadings > 0.3, Cronbach alpha > 0.7). The mean scores for on-time delivery, flexibility to deliver, and stock-out costs were particularly high, indicating that a substantial improvement on the said items had been perceived by companies as a result of information shared. Factor analysis for supplier dependency was satisfactory, which resulted in a single component with high loadings and Cronbach alpha. Factor analysis on buyer dependency resulted in one component. One indicator, specific investments into machinery or procedures was dropped as it loaded low on the construct. The scale reliability for the construct was high. For demand uncertainty, no factor analysis was required as the construct was considered to be formative. This is the case when indicators forming the construct can have different antecedents and do not necessarily correlate, e.g. the number of sales channels and the lead times of the products. Nevertheless, to support this claim, factor analysis was performed, which resulted in 3 components indicating the multidimensionality of the data. Ho et al. (2005), who developed the demand uncertainty construct, found four components in an explorative factor analysis with the same indicators, which they labeled as channel characteristics, product characteristics, demand forecast and, demand change. However, Ho et al. (2005) later in the study used the indicators as reflective, where the results were satisfactory. The correlation matrix in Appendix 1 Table 4 shows that the items were not highly correlated, which also support the argument that the indicators form rather than reflect the construct. Factor analysis on information sharing policy returned one component with high loadings and good reliability (see Appendix 6). Environmental uncertainty as a construct was perceived as a formative construct. Hoque (2005) used the indicators as reflective although the indicators do not necessarily have common antecedents, e.g. uncertainty in production and information technologies and market activities of competitors. The correlation matrix in Appendix 1 Table 6 shows that the items correlated weakly, which also supports this claim. Similar and satisfactory results were also obtained for the Swedish sample.

The partial least squares (using PLS-graph version 3.00) approach to structural equation modeling was used to test the hypothesized relationships for the two samples. The demand uncertainty and environmental uncertainty constructs were set as formative, whereas supplier dependency, buyer dependency, information sharing, and performance were set as

reflective and as according to the components of the factor analysis. Results of the model for the Finnish sample are shown in Figure 7.

Figure 7: PLS Results for Finland



**** significant at p<0.05**

In PLS, the measurement model is evaluated according to item loadings, reliability coefficients, convergent, and discriminant validity. Item loadings exceeding 0.7 are considered adequate (Fornell and Larcker, 1981) for reflective indicators. For formative indicators, the weights not the loadings are taken into consideration. Composite reliability, which is interpreted like Cronbach alpha for internal consistency reliability is considered adequate when greater than 0.7 (Fornell and Larcker, 1981). Average Variance Extracted (AVE), a measure indicating how much the indicators explain the variance in the construct is acceptable when it exceeds 0.5 (Barclay, Thompson, and Higgins, 1995). Discriminant validity is assessed by verifying that items across constructs have minimum correlations than with the corresponding construct.

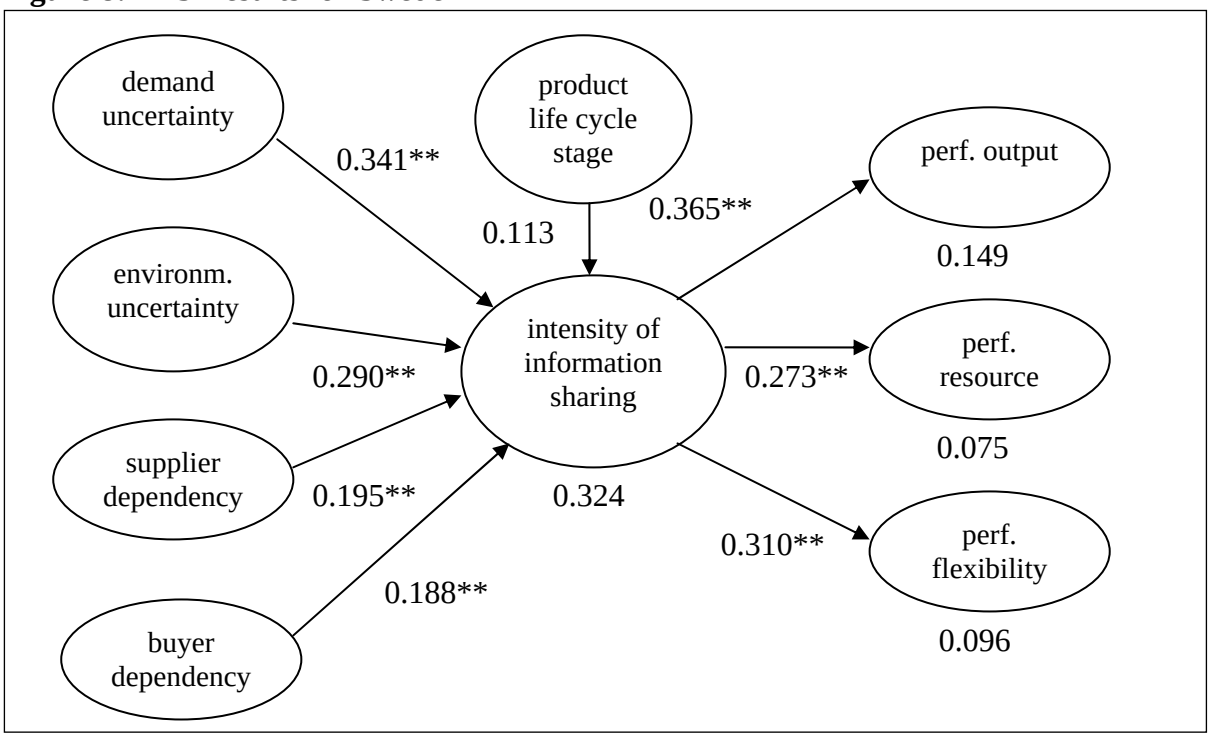
Appendix 2 presents the results for the measurement (outer) model in terms of item loadings, AVE, and composite reliability. All item loadings for the reflective indicators except product quality and personnel requirements were satisfactory, exceeding 0.7 (see Table 2). AVE and composite reliability were sufficient for all reflective constructs. Discriminant validity was checked by comparing the square roots of AVE to construct correlations. The correlations were all smaller than the square roots of AVE indicating that a construct shared more variance with its measures than with other constructs (see Appendix 2).

The strengths of the relationships (betas) and R squares are shown in Figure 5. In PLS, for testing the fit of the model, in addition to AVE values, t-statistics for the path coefficients must be checked. For this purpose, bootstrapping with 500 samples was generated. According to the t-statistics (see Appendix 3 table 2), all the relationships had a significant positive relationship with the intensity of information sharing except for H5 (PLC). Also, the intensity of information sharing was positively associated with performance H6a, H6b and H6c.

Results showed that out of the three performance measures, output performance had the strongest relation to information shared with key suppliers. Thus, all hypotheses except H5 were supported. For H5, the relationship was tested for curve linearity but this also yielded no significance.

The results for the Swedish sample are in Figure 8 and Appendix 2 (loadings/weights, AVE) and 3 (t-statistics). The results were very similar. All hypotheses except H5 were supported.

Figure 8: PLS Results for Sweden



**** significant at p<0.05**

Direct and saturated models were tested to compare with the proposed model. Results gave support that the proposed model was better than alternative models. The analysis was also repeated with the pooled sample (Finland + Sweden) and the results were similar; only hypothesis 5 was not supported. Finally, size and position in the supply chain were found not to have an affect on the intensity of information shared with key suppliers.

Conclusion

A model was developed to explain the level of information shared between a company and its key-suppliers. The model was separately tested with data from 119 Finnish and 112 Swedish companies. Results showed that uncertainty (both environmental and demand), and dependency had explanatory power (positive relationships) for the level of information shared with key suppliers, whereas the product life cycle stage of the focal company was found not to be significant. This study makes theoretical and methodological contributions by extending on a number of studies including Kulp (2002), Bagchi and Larsen (2002), and Li and Lin (2006). This is so with respect to the hypotheses on the relationship between uncertainty and information sharing, which were unsupported in Kulp (2002) and Li and Lin (2006). There is

also a contribution to transaction cost theory by investigating whether asset specificity and search costs play (dependency) a role in interorganizational information sharing. The results support this, confirming Dyer (1996) and Williamson (1991) that asset specificity encourages integration, although not only in the sense of vertical integration. One of the methodological highlights of the study was to use formative indicators as opposed to reflective indicators for demand and environmental uncertainty, which had not been done before best to my knowledge. This study also confirmed previous results with respect to information sharing leading to better firm performance especially regarding output. We argue that these results are generalizable as the hypothesis hold in two separate samples from two different countries.

As for the limitations of this study, first of all, only the buyer's perspective was investigated. Future studies should also include key suppliers or multiple parties in the supply chain. Furthermore, since a single respondent answered all the questions in the survey, the likelihood of common method bias has to be taken into account.

The overall results shed descriptive light on a common trend in supply chains today. Being contingent on a number of factors, the adoption of supply chain technologies/practices and information sharing is still limited and differ across companies and countries. An avenue for future research could be to focus on new ways of information sharing where the reward would exceed the risk of opportunism.

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Appendices

Appendix 1

Table 1: Measurement of Variables

Indicators	Scale	Reference
Environmental Uncertainty		**Hoque (2004)**
supplier's actions	1 to 7 Likert	
customer demands, tastes	1 to 7 Likert	
deregulation and globalization	1 to 7 Likert	
competitors	1 to 7 Likert	
production and information technologies	1 to 7 Likert	
government regulation and policies	1 to 7 Likert	
economic environment	1 to 7 Likert	
industrial relations	1 to 7 Likert	
Demand uncertainty		**Ho et al. (2005)**
a) rate of new product introductions	1 to 7 Likert	
b) predictability of product demand	1 to 7 Likert	
c) product life cycle	1 to 7 Likert	
d) product variety	1 to 7 Likert	
e) number of sales channels	1 to 7 Likert	
f) product to market time	1 to 7 Likert	
g) frequency of orders	1 to 7 Likert	
h) frequency of order changes	1 to 7 Likert	
i) frequency of orders expedited	1 to 7 Likert	
k) lead times*	1 to 7 Likert	
Supplier Dependency		
b) financial costs in switching	1 to 7 Likert	**Straub et al. (2004)**
c) the effort in switching	1 to 7 Likert	
d) asset specific investments	1 to 7 Likert	
Buyer Dependency		
b) financial costs in switching	1 to 7 Likert	
c) the effort in switching	1 to 7 Likert	
d) asset specific investments	1 to 7 Likert	
Product Life Cycle Stage		**Hoque and James (2000)**
emerging	percentage	
growth	percentage	
mature	percentage	
declining	percentage	
Intensity of Information Sharing		**Li et al. (2006)**
changing needs	1 to 7 Likert	
share proprietary information	1 to 7 Likert	
informed about issues	1 to 7 Likert	

business information	1 to 7 Likert	
business planning	1 to 7 Likert	
events and changes	1 to 7 Likert	
Resource Measures (performance)		**Beamon (1999)**
a) Inventory Levels/Costs	1 to 7 Likert	
b) Equipment Utilization, energy use and	1 to 7 Likert	
c) Operational Costs	1 to 7 Likert	
d) Personnel Requirements	1 to 7 Likert	
Output Measures (performance)		**Beamon (1999)**
a) Fill Rates	1 to 7 Likert	
b) Stock outs	1 to 7 Likert	
c) Product Quality	1 to 7 Likert	
d) On-time delivery	1 to 7 Likert	
e) Improvement in Customer Satisfaction	1 to 7 Likert	
f) documentation quality*	1 to 7 Likert	
Flexibility Measures (performance)		**Beamon (1999)**
a) product variety	1 to 7 Likert	
b) new product introductions	1 to 7 Likert	
c) flexibility to deliver	1 to 7 Likert	

Appendix 2

Table 1: Factor Analysis – Performance – Confirmatory - Finland

Factors	Loading	Variance	Cronbach	Item Mean	Stand. Dev.
Resource Measures		49%	0.813		
energy use	0.756			2.43	1.29
equipment utilization	0.736			3.47	1.48
operational costs	0.734			4.30	1.36
inventory turnover	0.662			4.58	1.47
personnel requirem.	0.584			3.19	1.55
Output Measures		56%	0.841		
on-time delivery	0.901			5.10	1.49
customer satisfaction	0.869			4.92	1.56
fill rates	0.780			4.15	1.68
stock-out costs	0.710			5.02	1.45
product quality	0.339			3.84	1.63
Flexibility Measures		50%	0.723		
new product introd.	0.897			3.89	1.68
product variety	0.687			3.53	1.68
flexibility to deliver	0.475			5.18	1.37

Table 2: Factor Analysis - Supplier Dependence - Finland

Factors	Loading	Variance	Cronbach	Item Mean	Stand. Dev.
Supp. Depend.		66%	0.828		
monetary costs	0.960			4.15	1.74
search costs	0.869			3.89	1.76
specific investm.	0.542			3.66	1.73

Table 3: Factor Analysis - Buyer Dependence - Finland

Factor	Loading	Variance	Cronbach	Item Mean	Stand. Dev.
Buyer Depend.		56%	0.893		
monetary costs	0.991			4.43	1.54
search, contr. costs	0.811			4.16	1.55

Table 4: Correlation Matrix for Demand Uncertainty -Finland

	uncert1	uncert2	uncert3	uncert4	uncert5	uncert6	uncert7	uncert8	uncert9	uncert10
uncert1	1.000	.231	.442	.462	.300	.236	.304	.178	.133	.080
uncert2	.231	1.000	.119	.298	.128	.188	.135	.276	.242	.241
uncert3	.442	.119	1.000	.268	.232	.127	.274	.147	.175	.080
uncert4	.462	.298	.268	1.000	.271	.139	.244	.214	.074	.162
uncert5	.300	.128	.232	.271	1.000	.054	.126	.155	.153	-.022
uncert6	.236	.188	.127	.139	.054	1.000	-.148	.145	.052	.260
uncert7	.304	.135	.274	.244	.126	-.148	1.000	.285	.284	-.041
uncert8	.178	.276	.147	.214	.155	.145	.285	1.000	.555	.224
uncert9	.133	.242	.175	.074	.153	.052	.284	.555	1.000	.181
uncert1	.080	.241	.080	.162	-.022	.260	-.041	.224	.181	1.000

Table 5: Factor Analysis – Information Sharing Policy - Finland

Factor	Loading	Variance	Cronbach	Item Mean	Stand.
Inf. Sha.		49%	0.868		
processes	0.792			4.25	1.39
informed	0.724			4.04	1.52
proprietary (1)	0.695			3.74	1.65
proprietary (2)	0.690			3.98	1.36
issues	0.688			4.87	1.15
needs	0.676			5.30	1.20
planning	0.642			4.13	1.45

Table 6: Correlation Matrix for Environmental Uncertainty

	env1	env2	envt3	env4	env5	env6	env7	env8
envrnuncert1	1.000	.000	-.069	-.094	.058	.176	.157	.235
envrnuncert2	.000	1.000	.232	.343	.244	.112	.098	.086
envrnuncert3	-.069	.232	1.000	.240	.247	.011	.234	.304
envrnuncert4	-.094	.343	.240	1.000	.403	.039	.256	.228
envrnuncert5	.058	.244	.247	.403	1.000	.185	.098	.279
envrnuncert6	.176	.112	.011	.039	.185	1.000	.304	.278
envrnuncert7	.157	.098	.234	.256	.098	.304	1.000	.499
envrnuncert8	.235	.086	.304	.228	.279	.278	.499	1.000

Appendix 2

Table 1: The Outer Model Finland

Factors	**l/(w)**	**AVE**	**Comp. Rel.**
Demand Uncertainty		NA	NA
rate of product introductions	(0.108)		
product demand	(-0.134)		
short life cycle times	(0.413)		
large product variety	(0.245)		
sales channels	(-0.025)		
product to market cycle time	(-0.604)		
frequent orders	(-0.256)		
changes in order content	(0.425)		
orders expedited frequently	(0.362)		
lead times of products	(0.281)		
Environm. Uncertainty		NA	NA
supplier's actions	(0.023)		
customer demands	(-0.123)		
deregulation and globalalizat.	(-0.279)		
competitors	(-0.063)		
production and IT	(0.397)		
government regulation	(0.876)		
economic environment	(0.055)		
industrial relations	(-0.139)		
Supplier Dependency		0.735	0.892
lost sales	0.894		
searching effort	0.883		
asset specific investments	0.791		
Buyer Dependency		0.899	0.947
monetary cost	0.947		
effort	0.950		
Intensity of Information Sharing		0.564	0.900
proprietary (1)	0.744		
needs	0.732		
proprietary (2)	0.735		
informed	0.725		
processes	0.807		
planning	0.727		
events	0.780		
Perform. output		0.627	0.921
inventory turnover	0.698		
operational costs	0.793		
stock-out costs	0.763		
fill rates	0.766		
on-time delivery	0.898		
flexibility to deliver	0.777		
customer satisfaction	0.833		
product quality*			

Perform. flexibility		0.642	0.843
personnel requirements	0.772		
product variety	0.827		
new product introductions	0.805		
Perform. resource		0.819	0.900
equipment utilization	0.928		
energy use	0.881		

***discarded as it loaded below 0.7**

Table 2: The Outer Model Sweden

Factors	**l/(w)**	**AVE**	**Comp. Rel.**
Demand Uncertainty		NA	NA
rate of product introductions	(0.638)		
product demand	(-0.082)		
short life cycle times	(-0.351)		
large product variety	(0.391)		
sales channels	(0.202)		
product to market cycle time	(0.254)		
frequent orders	(0.002)		
changes in order content	(0.175)		
orders expedited frequently	(-0.037)		
lead times of products	(-0.011)		
Environm. Uncertainty		NA	NA
supplier's actions	(-0.938)		
customer demands	(0.381)		
deregulation and globalalizat.	(-0.015)		
competitors	(0.129)		
production and IT	(0.027)		
government regulation	(0.187)		
economic environment	(0.495)		
industrial relations	(-0.162)		
Supplier Dependency		0.899	0.947
lost sales	0.935		
searching effort	0.963		
asset specific investments*			
Buyer Dependency		0.669	0.857
monetary cost	0.853		
effort	0.908		
asset specific invest.	0.674		
Intensity of Information Sharing		0.574	0.904
proprietary (1)	0.693		
needs	0.764		
proprietary (2)	0.751		
informed	0.812		
processes	0.688		
planning	0.827		
events	0.756		

Performance Output		0.714	0.909
on-time del.	0.879		
flex. to del.	0.865		
cust. satisfaction	0.851		
fill rates	0.781		
inventory turnover*			
stock-out costs*			
personnel requirements*			
Performance resource		0.710	0.880
energy use	0.848		
operational costs	0.868		
equipm. utilization.	0.811		
Performance flexibility		0.790	0.918
prod. variety	0.911		
new product introductions	0.911		
product quality	0.842		

***discarded as it loaded below 0.7 NA: Not Applicable**

Appendix 3

Table 1: Correlations of latent variables and square root of AVE in diagonal - Finland

	info_sha	resource	output	flexibility	demun	sup_dep	buy_dep	envun
info_sha	0.751							
resource	0.463	0.904						
output	0.604	0.643	0.781					
flexibility	0.396	0.487	0.610	0.801				
demun	0.336	0.280	0.311	0.304	NA			
sup_dep	0.305	0.286	0.391	0.221	0.167	0.857		
buy_dep	0.298	0.115	0.218	0.193	0.020	0.237	0.948	
envun	0.282	0.094	0.128	0.234	0.061	0.066	0.085	NA

NA: Not Applicable

Table 2: Path Coefficients Table (T-Statistic) - Finland

	info_sha	resource	output	flexibil	demun	sup_dep	buy_dep	envun
Info_Sha	0.0000	0.0000	0.0000	0.0000	3.3286	2.4415	2.9864	2.5155
resource	6.8901	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
output	9.8651	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
flexibil	5.2244	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
demun	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
sup_dep	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
buy_dep	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
envun	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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Table 3: Path Coefficients Table (T-Statistic) -Sweden

	info_sha	flexibil	output	resource	demun	sup_dep	buy_dep	envun
Info_Sha	0.0000	0.0000	0.0000	0.0000	4.2764	2.0241	2.2532	3.0855
resource	3.1215	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
output	4.1308	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
flexibil	3.3710	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
demun	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
sup_dep	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
buy_dep	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
envun	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000